Planning for Electronics Development

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The key to the growth of the Indian electronics industry ties in the identification of a few products with either a large domestic or export market potential. Production would then have to be organised on internationally competitive scales. This paper attempts to provide a basis and a method for identifying 'appropriate products: The electronics industry is classified into four sectors on the basis of technological and scale characteristics and the current and potential markets for these sectors are assessed. The author then indicates a few areas for special emphasis and outlines the nature of organisational support required by these product groups.

I

Introduction

THE Indian electronics industry is very small. In 1985, the total production was valued at $ 2,500 million. If the production had been measured at international prices, the value would have been only about a half, i c, $ 1,250 million. In 1985, the electronics production in South Korea was $ 7,500 million (it was about the same in Taiwan). In other words, the Indian electronics industry is currently less than one-sixth the size of the industry in Korea (or Taiwan).

Though small, the Indian industry is, for the most part, not young. The combination of being small and old is unfortunate. Smallness carries with it a number of disadvantages. However, a young industry, even when small is often capable of considerable dynamism. In India, the period of youth did not contain dynamic impulses mainly because the efforts were (and continue to be) very diffuse. At all times, the approach in India has been to produce an increasing number of products at extremely small (almost comic) scales of production; at such scales, manufacturing efficiency has necessarily been a low priority. In contrast, the successful countries have concentrated over significant time periods on a few products, established large scales of production, and made a conscious effort to improve manufacturing efficiency

There is a section of the Indian industry which is young and which has shown signs *of* dynamism: this is the part of the industry which I shall term below as the medium technology sector; it consists of firms making colour televisions and microcomputers, However, this dynamism has been fuelled essentially by liberal imports of 'kits' (or products in knocked-down form). Since there is no sign that the current dynamism will extend to the eventual export of these products, there is a serious possibility that imports may have to be curtailed. This will have the effect of reducing the degree of competition in the industry and will hence lead to reduced pressures for cost effective production.

The key to the growth of Indian electronics will have to be the identification of a few products with cither a large domestic or export market potential. Production would then have to be organised on internationally competitive scales. In this paper, I shall attempt to provide a basis (and a method) for identifying 'appropriate products'. In the next section (Section II), I shall first classify the electronics industry into four sectors on the basis of technological and scale characteristics; I shall then assess the current and potential markets for these sectors. I shall conclude in Section III by indicating a few areas for special emphasis and also outline the nature of organisational support required by these product groups.

II

Industry Structure

The electronics industry is very diverse. Many electronics products have a low technology content, while some products embody extremely high research input. In table 1, I have classified the industry into four sectors in terms of technology and scale levels; this classification is based on the structure of the industry in its international context. The scale of investment indicated pertains to the minimum required for efficient production; it is possible that, by making appropriate technology choices, the investment requirement under Indian factor prices is somewhat lower than indicated in the table.

ADVANCED SECTOR

Products in Group 1 are virtually not produced in India. The possible exceptions are some defence related products which have a high design content and which require sophisticated manufacturing. Even in the case of such products, the scales of production have been significantly lower than international standards. Similarly, India has been producing maniframe and minicomputers for about 15 years, but production scales have been extremely small.

The semiconductor complex (SCL) at Chandigarh was probably visualised as a constituent of this sector. But it has remained a virtual non-starter. On an investment of about $ 50 million, it produces a turnover of $ 5 million; even its relatively small production capacity is grossly underutilised.[1] On the basis of interviews I conducted, it appears that SCL has been reluctant to meet the demands for technologically simple but large volume products; instead SCL's sights have been set at sophisticated products which have little demand in India. As a consequence, SCL has missed the opportunity of gaining production experience.

This is a sector in which India currently does not have a comparative advantage. Any large-scale investments in this sector should therefore be discouraged (this statement would apply to recent negotiations to produce mainframe computers). The only reason for India to remain in this sector would be a strategic one. The strategic consideration can be of two types. Production could possibly be justified on the basis of defence requirements. But there is also a commercial factor. Products that are at present considered advanced will mature and their technology will become more widely accessible in the next several years. To commercially produce them at a later stage would require acquisition of experience and familiarity starting now. However, acquisition of experience does not imply setting up production facilities for all the advanced

TABLE 1: TECHNOLOGICAL STRUCTURE OF THE INTERNATIONAL ELECTRONICS INDUSTRY

Type of Sector	Examples of Products	Level of Technology		Scale of Investment
		Design	Manufacturing	
I Advanced	Advanced semiconductors, computers, telecommunication equipment	High	High	$ 100 M and above
II Design-intensive	Mini/supermicro computer systems, software, simpler telephone switching equipment	High	Medium or low	$ 5-25 M
III Medium technology	Colour televisions, video cassette recorders, disk drives, microcomputers	Low/medium	Low/medium	$ 5-50 M
IV Low technology	Black and white televisions, passive components, simpler semiconductor devices	Low	Low	$ 1-20 M

products. Rather, I would suggest the establishment of an integrated research and development organisation on the lines of the Electronics Research and Service Organisation (ERSO) in Taiwan. ERSO "combines reasonably sophisticated research capability in semiconductors, computers and telecommunications. In addition, it also has semi-commercial semiconductor production facilites (ERSO's facility is only slightly smaller than SCLs); the facility is used to produce prototypes of chips designed by domestic producers (the designs are produced either independently or in collaboration with ERSO).

At present, Indian research efforts are extremely diffuse. Bits and pieces are being done by several organisations. What I have suggested above is one central organisation doing research in one location and attempting to achieve synergies through combined research in the areas of semiconductors, computers and telecommunications. I would visualise a research staff of 500 people. Since SCL already exists, the cheapest way to set up such a facility would be for it to grow around SCL. As I shall discuss below, the alternative would be to build it around the Centre for Development of Telematics (CDOT) which has a young and motivated staff; however, CDOT does not have production facilities, and I think it is very important to have semi-commercial production facilities as part of the research organisation.

DESIGN INTENSIVE SECTOR

This is a relatively new sector: 5-6 years old in the US, 2-3 years old in Korea and Taiwan. The sector has developed for two reasons:

(1) design can be effectively separated from actual production for a number of electronic products;

(2) at the same time, there are continuously evolving design possibilities. For example, a large company may develop a product for a mass market. But because of the availability of a wide variety of components and because of the continuous appearance of new components (especially semiconductors), it becomes possible to make, sometimes small and sometimes significant, variations in design in order to meet the requirements of a more focused customer group (often referred to as a 'niche' market).

Countries such as Korea, Taiwan, Singapore, Philippines and India, which have followed farsighted policies with regard to technical education, have a possible advantage in this general area. However, before any specific policy action is taken, a number of issues need to be taken into account:

(1) This is a very diverse sector and it is necessary to identify specific areas within the sector for special emphasis; I shall try below to outline a few such areas,

(2) By the very nature of the market to which they cater, firms in this sector run into growth problems. As indicated above, the initial success of such firms depends on the identification of a specialised or 'niche' market. Such a market is, by definition, a small market. Moreover, a niche market does not stand still. It either disappears or it grows into a mass market. In the latter case, large firms, with their greater resources, enter the fray and the design-oriented firms then find it extremely difficult to compete.

(3) This sector is based on skilled manpower, and there is a general presumption that the potential Indian supply of such manpower is large. However, this may not be correct. The sector as it currently exists in India is very small (the aggregate turnover of this sector is probably around $ 50 million). In order for it to grow into a several hundred million dollar sector, the manpower requirement is going to be considerably larger than is indicated by current availability trends.

In India, design-oriented firms are engaged in a variety of tasks: design of sophisticated computer and telecommunication hardware, systems engineering (such as the design of a system for computerisation of airline reservation) and writing of software for running applications on computers. The sector has attracted a large number of domestic firms (ranging from big business houses to relatively small, but highly qualified, technical entrepreneurs). It has also attracted foreign interests (Texas Instruments, Citibank).

Technically, the most sophisticated are a few firms engaged in the design of advanced computer and telecommunication systems, utilising the most recent concepts and components. They are headed by professionals with considerable experience in the US and are manned largely by I IT trained engineers. In terms of technology, there is little difference between these firms and their counterparts in the US. I would include in this category firms such as PSI systems, Bangalore and the Centre for the Development of Telematics (CDOT), New Delhi; CDOT has done considerable design work, but has not yet transferred its designs to potential producers.[2] Among foreign firms, Texas Instruments has recently established a facility in Bangalore for designing integrated circuits. It is essential to support this group of firms, not merely for their current contribution but also for the role they could play in the coming decade.

At the next level of sophistication are firms engaged in the interdisciplinary task of configuring systems. This generally involves acquiring knowledge of the particular application and then choosing and linking the appropriate hardware. Firms in this activity may be thought of as project consultants.

Finally, the simplest and the lowest value-added activity involves writing instructions for the computer to perform certain applications, This activity is generally thought of as the 'software' sector and probably constitutes between a half and two-thirds of the Indian 'design-intensive' sector. Included in the sector are venerables such as Tata Burroughs and Tata Consultancy Services, which together account for more than half of India's $ 20 million software exports.

The software sector has been the focus of policy rhetoric It has been 'projected' by the Department of Electronics (DOE) that Indian software exports could be around $ 250 million by 1990, a more than 10-fold increase in less than 5 years. While the current low base is certainly an advantage for achieving high growth rates, the DOE targets are unlikely to be realised for a number of reasons:

(1) The writing of software for mass application markets has become a very resource intensive activity. For example, Lotus Corporation (famous for its spreadsheet package) has spent over $ 20 million over the past few years trying, unsuccessfully to repeat its performance with LOTUS 1-2-3, Recently, IBM has invested significant resources in software development for its next generation of personal computers. It, therefore, seems unlikely that Indian firms will be able to compete seriously in such markets, Tata Burroughs, the strongest Indian firms in this category, recently developed a package, called EASY DEAL, for foreign exchange transactions. According to industry sources, however, the Indian firm has been preempted by IBM. If Indian firms want a share of this market, it will have to be through sub-contracting relationships; such relationships will require strong marketing efforts, India's most serious competitor may turn out to be Philippines where domestic firms have been making significant progress in creating a credible image.

(2) There is some concern in the Indian software industry that Indian programmers have insufficient exposure to modern software production 'tools' and hence are considerably less productive than their American counterparts. The tools essentially embody frequently used sequences of computer programmes and also have in-built editing facilities. The concern with lack of exposure to these tools is being used as the basis for seeking liberalisation of their imports. It should be noted, however, that an important section of the industry disagrees regarding the usefulness of software tools; this section of the industry feels threatened by the possible imports of software tools since that would undermine its current activity. It has not been possible for me to assess this conflict, it is likely, however, that the conflict may have to be resolved not on the basis of the issues outlined above but rather may be determined by a characteristic of applications software: the ease with which it can be copied. Imports of software may have to be permitted to nullify smuggling and piracy and also to create an international

acceptability for Indian products.

(3) Finally, the exports of the Tata firms (and some other smaller players) have been based on the need to upgrade and modify existing software. This market is created by the progress in computer hardware. There is some indication that the market is unlikely to grow and may even dwindle as hardware designers have been made increasingly condous of maintaining compatibility with existing software.

MEDIUM TECHNOLOGY SECTOR

While design input has often been important in the medium technology sector, it is manufacturing efficiency that has been critical. Product demand has generally grown at a stable rate In contrast to some products in the advanced sector, design improvements in the medium technology sector have been incremental rather than drastic and abrupt. As such, production efficiency has not been based on proprietary knowledge (or 'tricks'), but rather on careful production planning. An important dimension of this planning has been the choice of an appropriate scale of production.

This sector has been especially important in Korea (and to a somewhat lesser extent in Taiwan). In particular, the manufacture of colour televisions has provided the Korean producers both financial and technological benefits.

It would be useful here to briefly review the Korean experience. In the late 1970s, the interest of Japanese producers shifted from the production of simple TVs on a mass scale to the production of TVs differentiated by the addition of novel features. The large Korean conglomerates saw the opening and set up large production facilities, initially to produce 'plain-Jane' or simple, TVs. Several features of the production system that evolved arc of interest:

(1) Production came to be concentrated in the hands of three major Korean conglomerates (Gold Star, Samsung and Daewoo); today each of them produces over a million colour TV sets a year.

(2) The production took place without any technical or financial collaboration.

(3)'The government provided active support by insulating the domestic market from foreign competition, providing credit support and by expanding TV transmission to boost domestic demand.

(4) The profits from TV production contributed to the ability to undertake risky, high technology ventures, such as production of advanced semiconductors; the technical and organisational knowledge gained in the process of making TVs has been transferred to other products (such as monitors and terminals for personal computers, personal computers and video tape recorders). As such, television manufacture provided for the organic growth of the Korean electronics industry.

It is important to understand the nature of scale economies in the manufacture of colour televisions (and other medium technology products). The scale economies are partly technological; minimum scales of production are required to justify the use of certain types of equipment and for the efficient organisation of the assembly line, It does not, however, follow from the Korean example that a single firm must produce in the range of a million sets annually in order to achieve technological economies. In Taiwan, production scales of the largest firms are in the range. of a few hundred thousand and, in terms of production costs, they do equally well. The reason why the Taiwanese are losing market share to the Koreans lies more in the economies the Koreans are able to achieve in the buying of inputs and marketing their output.

In contrast to the Far Eastern countries, India has a relatively new middle technology sector: the sector in India is not more than 5 or 6 years old. On the face of it, the newness has been accompanied by some degree of dynamism. This dynamism has been fuelled principally by liberal imports of so-called 'kits' (for colour televisions and personal computers). The liberal import has brought down domestic prices (the prices, however, continue to be more than twice the international level). One also finds some degree of production rationalisation taking place in the industry, particularly in the colpur TV segment. The largest firms have expanded their scales of production to about 50,000-60,000 sets annually. These firms have also been attempting to improve their manufacturing technology, some of them with the aid of Japanese firms. There is an expectation that the larger firms will further expand their scales of output and hence reduce production costs.

However, a number of problems remain:

(1) The process of cost rationalisation is not taking place fast enough. The expansion in demand for colour TVs has slowed down and is not expected to regain the earlier momentum unless further investments in transmission infrastructure and programme quality are made. The demand for, and hence the production of, personal (micro) computers continues to be abysmally small and there appears little prospect of economical production scales appearing in the next few years.[3]

(2) There certainly was no indication from my interviews that Indian producers have any interest (or capability) in entering export markets. This has a major implication for the further growth of the sector. As noted above, past growth has principally depended on liberal import policies. It is unlikely that such policies could be continued indefinitely if exports are not forthcoming,

(3) Technology development has been very slow. Given their penchant for diversifying, Indian firms have largely been importing product technology, rather than 'process' technology. Moreover, of the very large number of technology agreements signed in 1985, a significant number have remained paper agreements (notably in the case of telephone sets and other telecommunication equipment). Internal learning has undoubtedly been taking place, but again at a slow pace; the low investment in learning is largely due to the fact that Indian producers do not have long term commitments to particular product lines.

(4) Large business houses, who should have a long term perspective and commitment and who have been allowed by recent policy changes to participate in this sector, have not yet made any major moves. For example, NELCO of the TATA group, is regarded by industry observers as, at best, an also-ran in the colour TV industry. There have been reports in the trade press of management changes and technology tie-ups (with Mitsubishi and Honeywell), but there seems a danger that NELCO may be spreading itself thin.

The Indian middle technology sector is thus in danger of being caught in a trap of small scales of output. Such a trap has affected other Indian products (both electronic and non-electronic). The trap has the following nature:

(1) Because of high prices and relatively undeveloped infrastructure, demand for final products is low;

(2) as a consequence, the demand for components is small, preventing the development of a components industry; however, since components are necessary, producers of final products tend to be more vertically integrated than their international counterparts; and finally,

(3) the small size of the market is compounded by the uncertainties (particularly those stemming from lack of direction in government policies); as such, there is a strong incentive to diversify into new products rather than expand in the same line of production.

In Section III, I shall suggest possible methods of avoiding this trap.

Low TECHNOLOGY SECTOR

In this sub-section, I shall first briefly discuss the status of the black and while television industry and then outline, in some detail, the prospects and problems of the passive components sector. I should stress that the passive component industry has been criminally neglected and it is perhaps not too late to make it a significant export earner.

Black and white televisions

Given its constraints, the black and white TV industry has done remarkably well. The production in 1985 was about 1.2 million sets and there is virtually no import content in these sets. Unfortunately, production is extremely dispersed and the cost of Indian

components is high. As such, the industry at present is not export competitive I should imagine that with a better component base, a few of the larger Indian producers should be in a position to generate significant export earnings.

Passive components

Electronics components require very varied technology inputs. Advanced semiconductors require extremely high capital intensities and large production scales. At the other extreme are passive components (resistors, capacitors, coils) which achieve scale economies at relatively low investment levels ($1-2 million) and which despite significant technology upgradatioh in the past decade, employ more people per dollar invested than any other electronics sector: a million dollars of investment can employ about 60 people if the plant works 3 shifts.

It should be noted that although the international passive components market is not as dynamic as the market for more advanced products, it is still a substantial market (probably in the range of $ 3-4 billion) and it is also relatively stable. The passive component firms of East Asia are coming under increased pressure. They have typically been small firms and have not been able to grow organically. Today they also face constraints of increasing labour and land costs. In Korea and Singapore, in particular, there are already clear indications that these firms are unviable under current cost conditions. This-presents a clear opportunity for India. The possibility of significant exports has been demonstrated by JV Electronics, Delhi, which exports large volumes of mica capacitors to the USSR. But there is also a very real prospect of substantial exports to hard currency areas. The possibility is perhaps best demonstrard on the basis of a case study (see Appendix).

I would estimate that if transportation and customs problems are sorted out, on an investment of $ 200 million, India could generate between $ 500 and $ 600 million of exports. These exports will not be net exports, since raw materials would have to be imported. But given adequate demand, the raw material and capital goods industry should emerge, creating greater value added within India.

There is another reason why passive components are important. Starting in the late 1960s, first via Japanese capital and then through domestic entrepreneur ship and capital, the countries of East Asia (South Korea, Taiwan, Singapore and Hong Kong) developed very large passive component industries. The impetus was mainly the export market, but there was an important spillover effect for domestic producers of final products, who therby had easy access to cheap and reliable components.

However, the currently existing Indian passive component firms will not be able to tike advantage of the international opportunity; nor will they be able to provide cheap and reliable inputs for the medium technology sector. While it was correctly perceived that passive components can be produced in small scale firms, the Indian firms that emerged have tended to be ridiculously small Even the small passive component firms require investments *of* at least a million dollars.

lb sum up, I would suggest an export-oriented strategy to breakout of the bind created by existing small production scales, Such export orientation will also create strong linkage effects in the domestic economy; in particular, it will provide a necessary basis for the future growth of the middle technology sector.

Ill

Recommendations

PRODUCT AREAS

I shall start with what we should not produce. I am unable to see a good argument for the production or import of VCRs and microwave ovens. Similarly, I see no reason to produce advanced semiconductor devices (such as microprocessors and random access memories), mainframe and even mini computers. In these areas our production scales are very low, and we are very far behind world standards. By the time we catch up, the character of such products would have completely changed. Also, it seems premature to produce silicon for use in domestic semiconductor production. For advanced electronics products, 1 would suggest instead a large, integrated research unit with semi-commercial production facilities for semiconductor devices, on tines of ERSO in Taiwan; the current research is far too diffuse and dispersed, and during my fieldwork I found little evidence of communication between different research facilities.

The emphasis should be on the production of components: passive components and simple semiconductor devices, such as small scale (and possibly some large scale) integrated circuits. The export of black and white and colour TVs could be a possibility if the component base is improved and scales of production are increased. In the design intensive sector, the emphasis should be on hardware and systems design; while the software sector should be promoted, less hopes should be placed on it.

ORGANISATIONAL FORMS

There seems little doubt that the best and most "appropriate" technology can be identified and operated in India. In the course of my fieldwork, I saw sufficient evidence of this. The reason why Indian electronics (and Indian industry) often fails to adopt the appropriate technology is that the organisational forms are generally inappropriate. I have already suggested the nature of the research centre for the advanced sector, and so shall consider the other sectors below.

Medium technology sector

In Korea and Japan (and to a lesser extent in Taiwan) the lead was provided by big business which produced consumer electronics products on a large scale and used that as a base to move into high technology products. In India, big business was prevented from entering consumer electronics "till recently. It is difficult to speculate what shape the industry would have taken if this restriction had not existed. However, the recent liberalisation has not brought forth any significant investment from big business houses.

Given the unwillingness or inability of big business, one can think of three organisational forms, two of which have been tried and a third is in the process of being tried.

(1) Since the Indian consumer electronics has grown as a very dipersed industry, one could attempt to reduce costs by collective buying of inputs and selling of output. A plan of this kind has been initiated by the Electronics Trade and Technology Development Corporation. One sensible feature of this programme was the designing of a no-frills colour TV which could appeal to a mass market. There is little official word on the success or otherwise of this programme. However, most industry observers claim that it has run into severe co-ordination problems.

(2) A multinational operation producing principally for exports is a second alternative. One example of successful multinational operation is Jugi Tandon's facilities for making disk-drives (and its components) at the Santacruz Electronics Export Promotion Zone. The organisation of production and choice of techniques at the different stages of production have been carefully thought out. There are only a few product lines, so that efficient large scale assembly operations have been organised. If this form of organisation is desired, then two further issues arise Tendon happens to be an Indian and, perhaps, has been attracted by more than economic interests, though it is clear that he is making money. Why are other multinationals not attracted? Why, for that matter, do *so* few Indians return to *set* up manufacturing facilities? The answers probably lie in the kinds of problems outlined below in the case study of the resistor manufacturer.

Secondly, Tandon's operation has had little backward linkage effects on the economy. A leatest all components are imported. In this regard, there is little reason *to* fault Tandon. If a local components industry were to be developed, there would be every reason to source his components from domestic producers. But, in the meantime, this limitation must be recognised.

(3) I had referred above to the Centre for Development of Telematics and classified it as part of the design intensive sector However, CDOT is in the process of transferring its technology to domestic producers, who then, in a manufacturing sense, would come under the middle technology classifi-- cation. At present, CDOT is negotiating with 40 prospective producers for the transfer of technology. If all 40 set up operations, I think it would be sad, because it is unlikely that they would be able to achieve production rationalisation.

However, first of all, it is extremely unlikely that all 40 will start production. Secondly, mitigating against loss of scale economies at the stage of final production is CDOT's innovative, and, indeed, brave, policy with regard to component design and production. In its design, CDOT has sought to minimise its component types; moreover, from an early stage, CDOT has attempted to involve and educate potential component vendors.

Though the first organisational form is sound in principle, my judgment is that a combination of types 2 and 3 would best permit achievement of economical production scales.

Design intensive and tow technology sectors

Firms in both these sectors tend to be small on average (with low-tech firms being smaller than the design intensive firms). There is not much, besides the obvious, that I can state. Both types of firms need help in marketing; design oriented firms need offices located in their potential markets to respond quickly to demand. Design oriented firms need good communications, low-tech firms need quick and efficient transportation. Finally, design oriented firms need the availability of venture capital. Though these are obvious notions, suggestions for operationalising them would require considerable thought.

Appendix

PRODUCTION OF PASSIVE COMPONENTS: A CASE STUDY

A non-resident Indian who produces carbon film resistors in Singapore decided to set up a new and larger facility in Bangalore. Faced with growing demand, he found Bangalore a more attractive site to expand in because of lower land and labour prices. With financial support from term-lending institutions, he was able to set up his plant and install his equipment in a period of 8 months. The investment was about $ 1 million. The machinery was imported from Japan and the finished facility is as good as the best in Korea or Taiwan. Being a 100 per cent export unit, the entrepreneur could import inputs at international prices.

When he was all set to export to major Western firms, his machines began to catch fire because of voltage fluctuations, in fixing a high tension wire and installing appropriate voltage stabilisers, he lost over a year. During this period he incurred heavy losses because he had to buy resistors at a premium in order to meet his commitments. Over the last year, he has had exports worth $ J million, but it could have been as much as $ 3 million. He has faced problems because his technicians (trained by him in Singapore) and his production workers belonged to different linguistic groups. But more importantly, customs and transportation of goods (within India and to and from India) have enormously slowed him down.

Notes

(The views contained in this paper are those of the author and should not be attributed to the institutions to which he has been affiliated.]

1 SCI has a capacity of about 1,000 wafer starts per week, as against international scales of 1,000-1,500 wafer starts per clay

2 Possibly Tata rlesi should also be included in this category: a collaborative venture between the Tatas of India and Flexi of the US, it is located in Singapore; established in 1982, the firm has been largely unsuccessful in finding markets for its products

3 *Les*s than 10,000 microcomputers were produced in 1985 and the current production rate is unlikely to be more than 10,000, as against that, Samsung and Daewoo of Korea each export about 1,00,000 microcomputers, besides producing for the domestic market.

DISCUSSION

Pesticides vs Human Welfare

K N Mehroira

IN a recent communication Dinesh Mohan[l] has suggested that there is a positive and significant correlation between the intensity of pesticide use per hectare in various regions of the country and (a) the prevalence rates of deformity of limbs, (b) dysfunction of joints, (c) amputations, and (d) visual disabilities in India. He supports this contention by one table and four graphs. He also suggests that the incidences of above-mentioned four maladies are higher in those regions of the country which practised intensive agriculture (green revolution technology). He further suggests that a similar relationship exists between fertiliser consumption per hectare and amputation, and kilometre rail-road per person and paralysis (see table 2 of Dinesh Mohan's paper), In my opinion this is an oversimplified view of a very complex phenomenon. It is generally agreed that one should be very careful before inferring a causal relationship from the discovery of a correlation between two sets of data. The use of statistics, if not done properly, can be highly seductive and is likely to lend a spurious validity to the data. Dinesh Mohan's study suffers from this failing. Thus the correlations reported are not only fictitious and misleading but deserve to be treated with extreme scepticism.

The extent of pesticide residues in Indian environment and their harmful effects are very well recognised and have been discussed extensively [2-7] but one must remember that these pesticides have been used mainly to control insect pests affecting agricultural production and human health. On both these counts the pesticides have played a very important role. In fact DDT has been credited with having influenced human society immensely, more than any chemical including gun powder, plutonium or penicillin (8). It may be stated that organochlorine compounds, specially DDT and BHC, have come under severe criticism because of their long residual activity and biomagnification in the environment. We may and should, as Dinesh Mohan rightly does, give credit to Rachel Carson [9] for focusing the attention of the world on the harmful effects of pesticides. Most of the claims of Rachel Carson, however, are exaggerated and have been refuted [10]. The role of pesticides in relation to human welfare has been discussed all over the world rather emotionally. Charges and counter-charges have been made expressing conflict between the social values of public, economic value of agriculture and pesticide industry and adverse effects on environment and ecology (1114). But the fact remains that pesticides are being used, and will continue to be used, to con tain losses in agricultural production and protecting human society from affiliations perpetuated by insect vectors. The annual loss due to insect pests and diseases in agricultural sector is around Rs 15,000 crore and the man-days lost due to insect borne diseases, especially malaria, is 20-25 million [15]. DOT and BHC have been used extensively to avoid these losses since 1948-49. Environmental impact of the use of DDT and BHC in India have been reported and recommendations made [16-18]. Dinesh Mohan is not being charitable when he states that "no serious efforts have been made to do anything about it" and that the scientists are evasive on this issue. Use of environmentally safe, economically viable and socially acceptable methods of insect pest control have been suggested for the country but they need implementation [15, 19, 20]

Realising the harmful effects of pesticides [21] their registration, manufacture and import in India are regulated by the Insecticide Act (1968), Insecticide Rules (1971) and the Insecticides (Amendment) Act (1977). Dinesh Mohan rightly points out that the Insecticides Act needs drastic modification and rigorous implementation. It may be added that it is unfortunate that although there have been two workshops on the enforcement of Insecticides Act, the first one held on February 11-12, 1974 and the second on April 19-21, 1979 and their recommendations are available [22], still no action has been taken on those recommendations by the